MULTIMEDIA UNIVERSITY ™

STUDENT ID NO

MULTIMEDIAUNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019 SESSION

EEL3086 –SWITCHGEAR AND PROTECTION

(LE)

11th MARCH 2019
02:30 P.M - 04:30 P.M.
(2 Hours)

INSTRUCTION TO STUDENT

1. This Question Paper consists of 3 pages with 4 Questions only.

2. Answer **ALL** questions. All questions carry equal marks and thedistribution of marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) What are the abnormal conditions for power systems for which protection relays are not supposed to operate? Explain the reason in detail. [5 marks]

(b) Explain the operation of an overcurrent relay through suitable block diagram and discuss the relay plug setting and time setting. [8 marks]

(c) Explain the current transformer (CT) burden and its specification. [4 marks]

(d) Distinguish the remote back-up and relay back-up used in protection systems. [8 marks]

Question 2

(a) A CT has a rating of 50 VA, 400/5 A, 36 kV, 50 Hz. It is connected into an ac line, having a line-to-neutral voltage of 14.4 kV. The ammeter, relays, and connecting wires on the secondary side poses a total impedance (burden) of 1.2 Ω. If the transmission line current is 280 A, calculate

i) the secondary current [6 marks]
ii) the voltage across the secondary terminals [2 marks]
iii) the voltage drops across the primary [2 marks]

(b) An alternator with a line to line voltage of 11 kV is connected to a circuit breaker. The inductive reactance up to the circuit breaker is 5 Ω per phase. The distributed capacitance up to circuit breaker between phase and neutral is 0.01 μF. Calculate,

i) the peak restriking voltage across the circuit breaker, and write expression for the restriking voltage [6 marks]
ii) the time for peak restriking voltage [2 marks]
iii) an average rate of rise of restriking voltage [2 marks]
iv) the frequency of restriking voltage oscillation [2.5 marks]
v) the maximum RRRV. [2.5 marks]

Question 3

(a) An 11 kV, 100 MVA generator is provided with differential scheme of protection. The percentage of the generator winding to be protected against phase to ground fault is 85%. The relay is set to operate when there is 15% out of balance current. Determine the value of the resistance to be placed in the neutral to ground connection, when the required earthing resistance is to protect 90 % of the winding. [7 marks]

(b) Draw the functional block diagram of numerical relay and list out the various components. [10 marks]

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(c) Information provided for an overcurrent relay as follows: the current rating is 5 A, plug setting = 3, Time Setting Multiplier = 0.4, CT ratio = 500/5. An asymmetrical fault current apeares at relay location and consists of 2 kA and 500 A of ac and dc components respectively. Determine the operating time of the relay for the following relay characteristics. [8 marks]

Table Q3c

Plug Setting Multiplier (PSM)	2	4	5	8	10	20
Operating time in seconds at TMS = 1	10	5	4	3	2.8	2.4

Question 4

(a) State the abnormal conditions of generators. Which type of protection is selected for these conditions? [10 marks]

(b) Define the following terms:

i) Restriking voltage [1 mark]
ii) Recovery voltage [2 marks]
iii) Arc Voltage [2 marks]

in power system theory of circuit breaker. Sketch Restriking voltage across breaker contacts and Restriking voltage when asymmetrical current is interrupted in a circuit breaker. Explain each condition. [10 marks]

End of paper.